Updated Heavy Truck Air Chamber Force Data Charts

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In the early 1990s Heusser (1) published a paper describing the calculation methodology which would yield the approximate deceleration rate for a heavy truck or tractor-trailer equipped with an air-brake system. The equations and work-flow published required the analyst to utilize the pushrod force for the specific air chamber, based on the pushrod stroke and air pressure applied. The pressure/stroke/pushrod force charts were published and were used in several spreadsheet solutions and computer programs publicly available. These charts were an average set of data obtained from several air chamber manufacturers. The manufacturers agreed to provide the data and allow it to be published as long as all the data was averaged and could not be associated with any particular manufacturer.

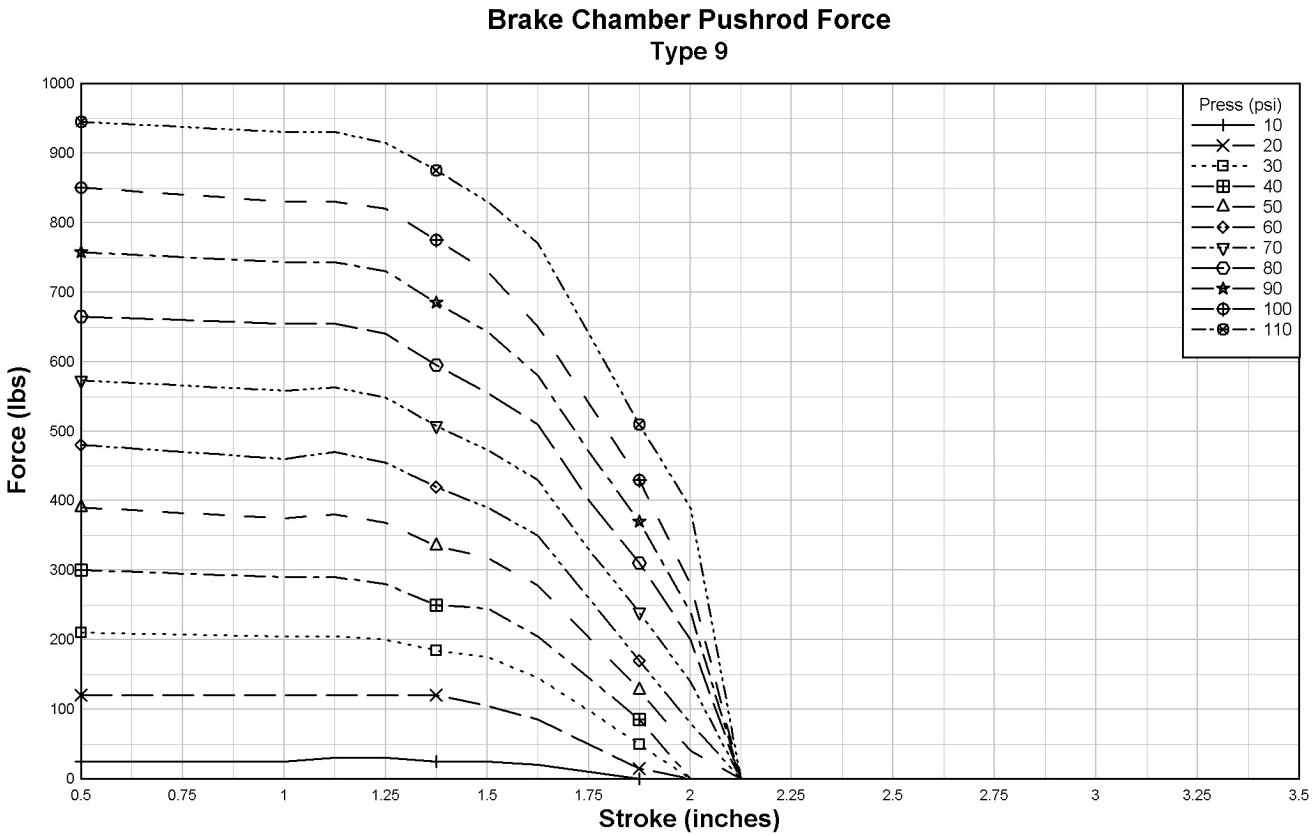
In the early 2000s air chamber manufacturers produced updated pressure/stroke/pushrod force data, which was again averaged between the different manufacturers. The data were assembled in a manner similar to the original data produced in the 1990s. At a later time a group of individuals also produced data for the Type-18 chambers which are commonly used with air-disc brake systems(2). Many analysts have had access to this data for several years, but it has come to our attention that the updated charts may not be known to some reconstructionists. That is the purpose of this article. Charts and tables for all of the updated data are included. When comparing this data to the earlier data it is clear that data around the 'knee' of the charts have slightly changed. It is unknown why this data has changed, whether from an update in the design, materials, manufacturing process, updated testing devices, or for some other reason. The authors feel that this updated data is the most accurate data for the majority of the vehicles on the road today.

This data should only be used by analysts that have been properly trained in performing the brake force calculations and have an understanding of the limitations of these calculations. An effort has been made to assemble the data and present it as accurately as possible, the authors make no guarantees and the authors will not be held responsible for any inaccuracies. Analysts should carefully review the data and use it at their own risk.

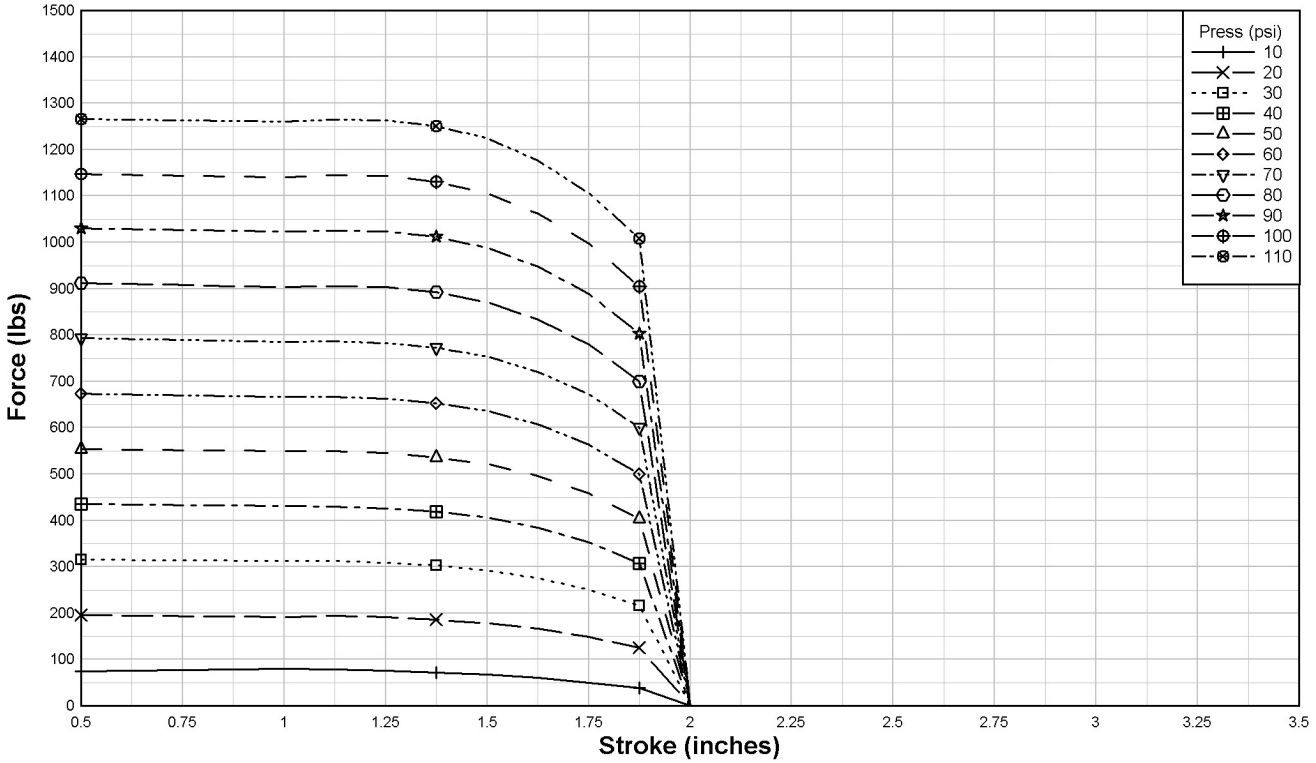
References:

1 - Heusser, Ronald B., "Heavy Truck Deceleration Rates as a Function of Brake Adjustment", SAE Paper No. 910126, Society of Automotive Engineers, Warrendale, PA, 1991.

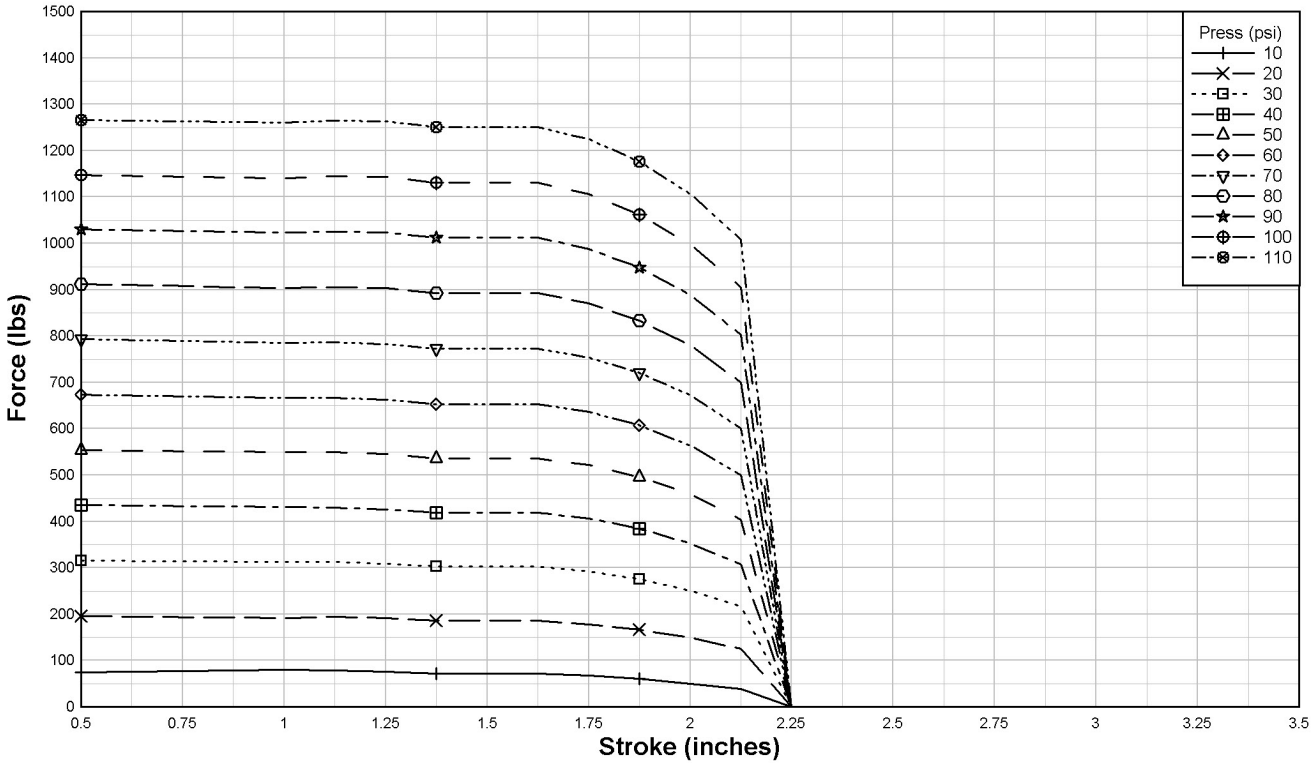
2 - Skinner, Scott and Dobson, Walter, Testing completed at IPTM Special Problems Conference, May 2015, data gathered utilizing equipment designed by Dr. Jeremy Daily at University of Tulsa.


Brake Chamber Pushrod Force
Type 9
Force (lbs)
Stroke (inches)
Press (psi)
10
20
30
40
50
60
70
80
90
100
110
0
100
200
300
400
500
600
700
800
900
1000
0.5
0.75
1
1.25
1.5
1.75
2
2.25
2.5
2.75
3
3.25
3.5

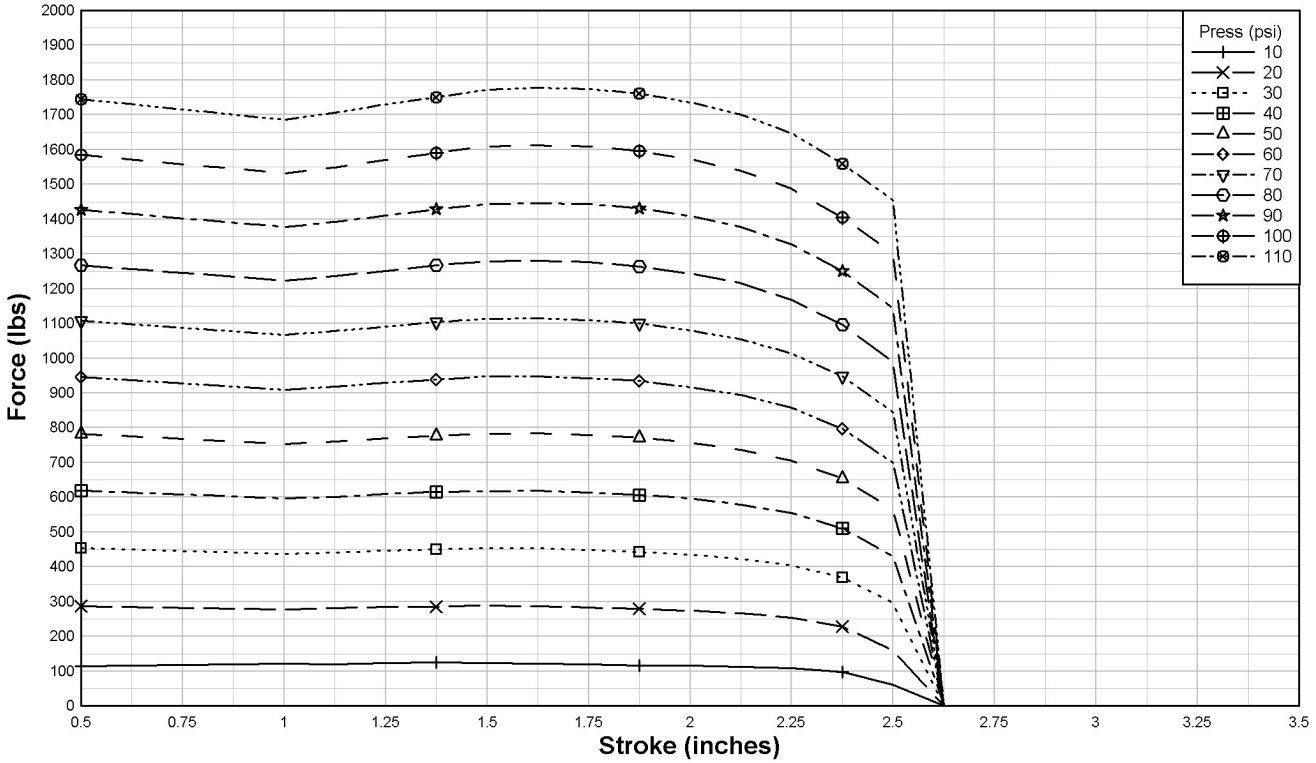
Brake Chamber Pushrod Force
Type 12



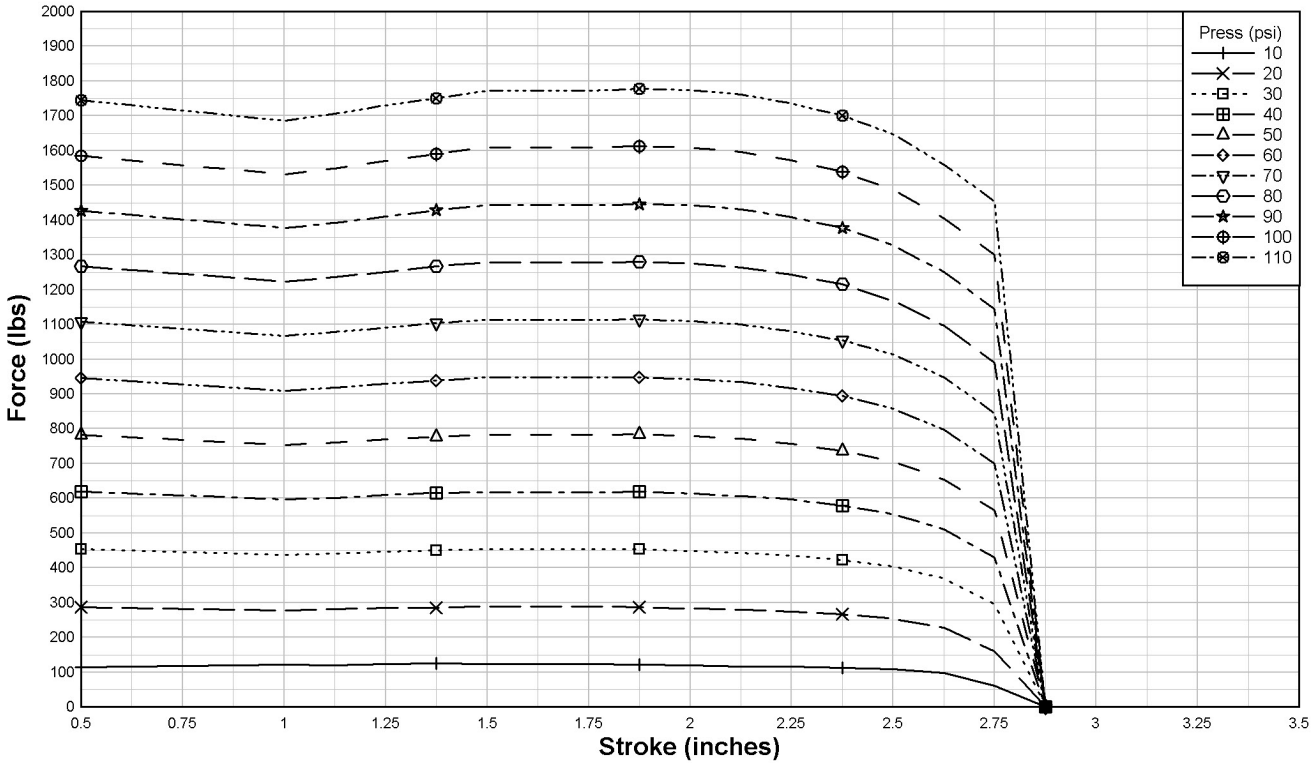
Brake Chamber Pushrod Force
Type 12 Long Stroke



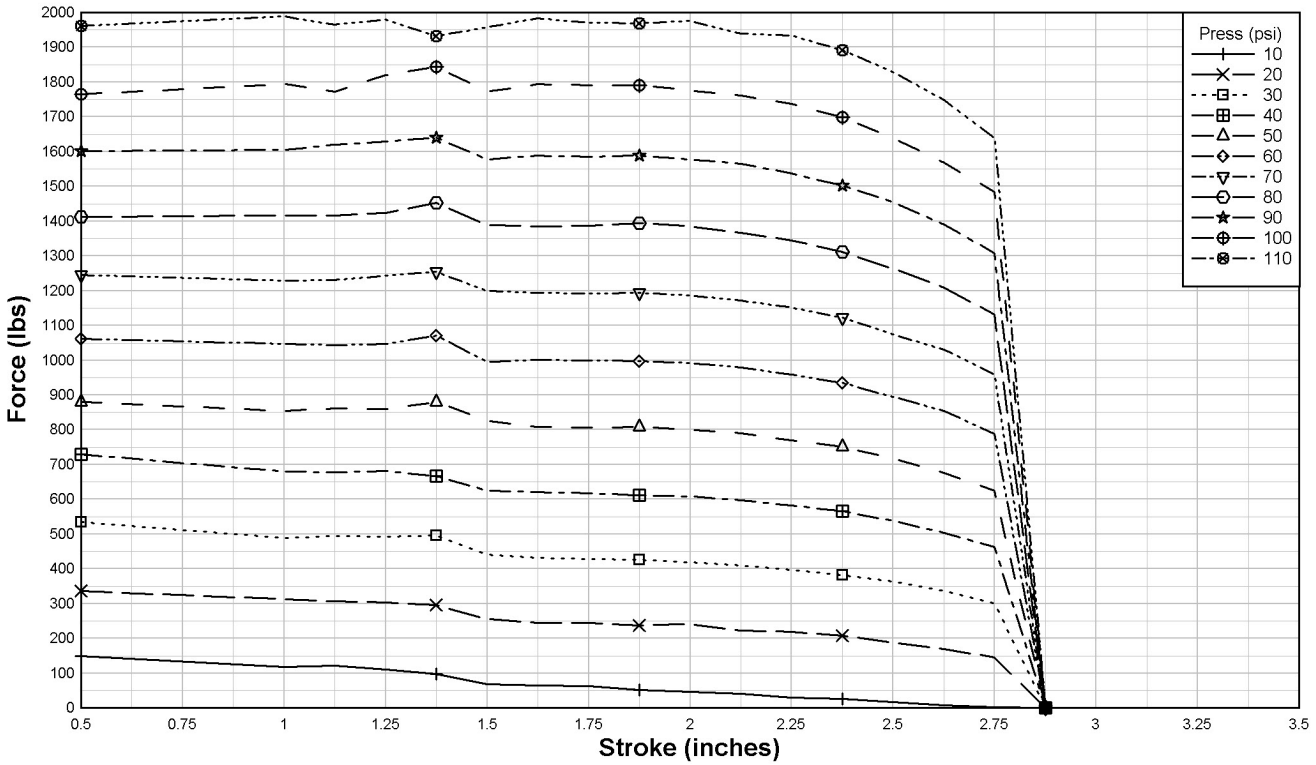
Brake Chamber Pushrod Force
Type 16



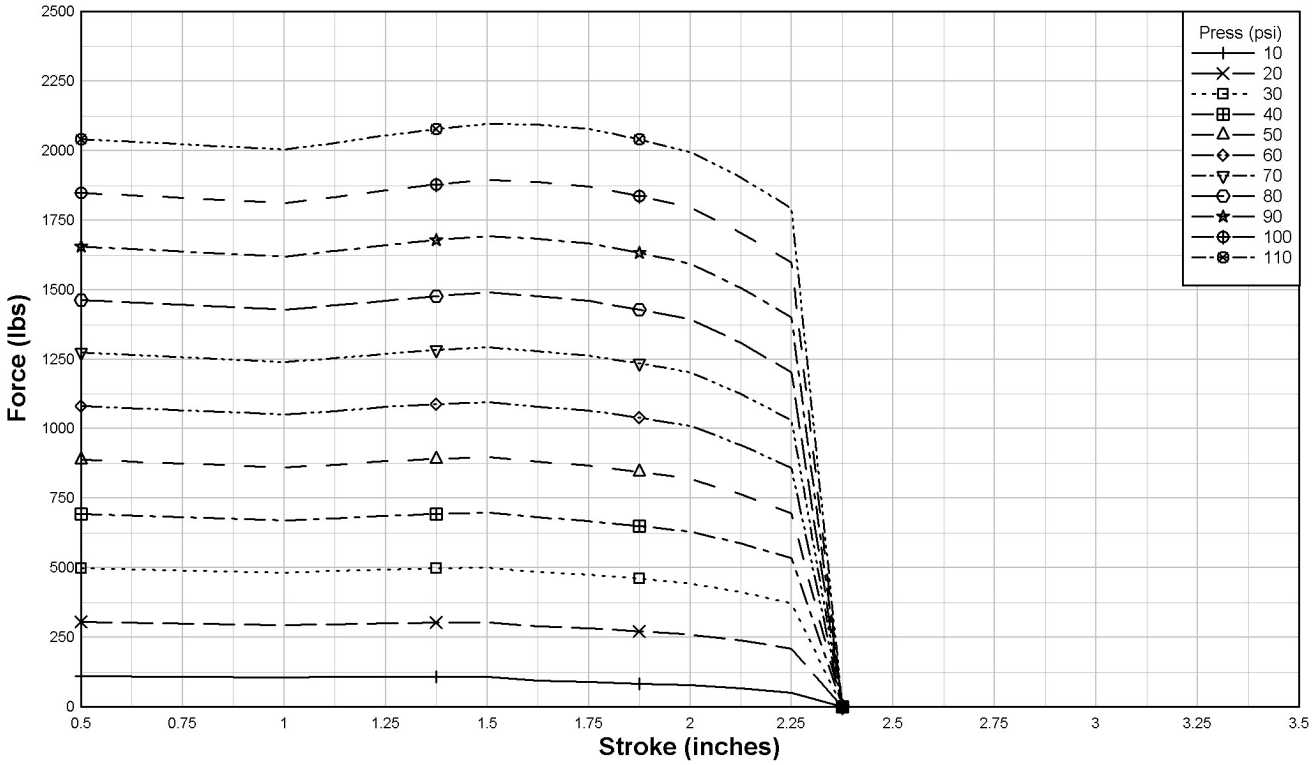
Brake Chamber Pushrod Force
Type 16 Long Stroke



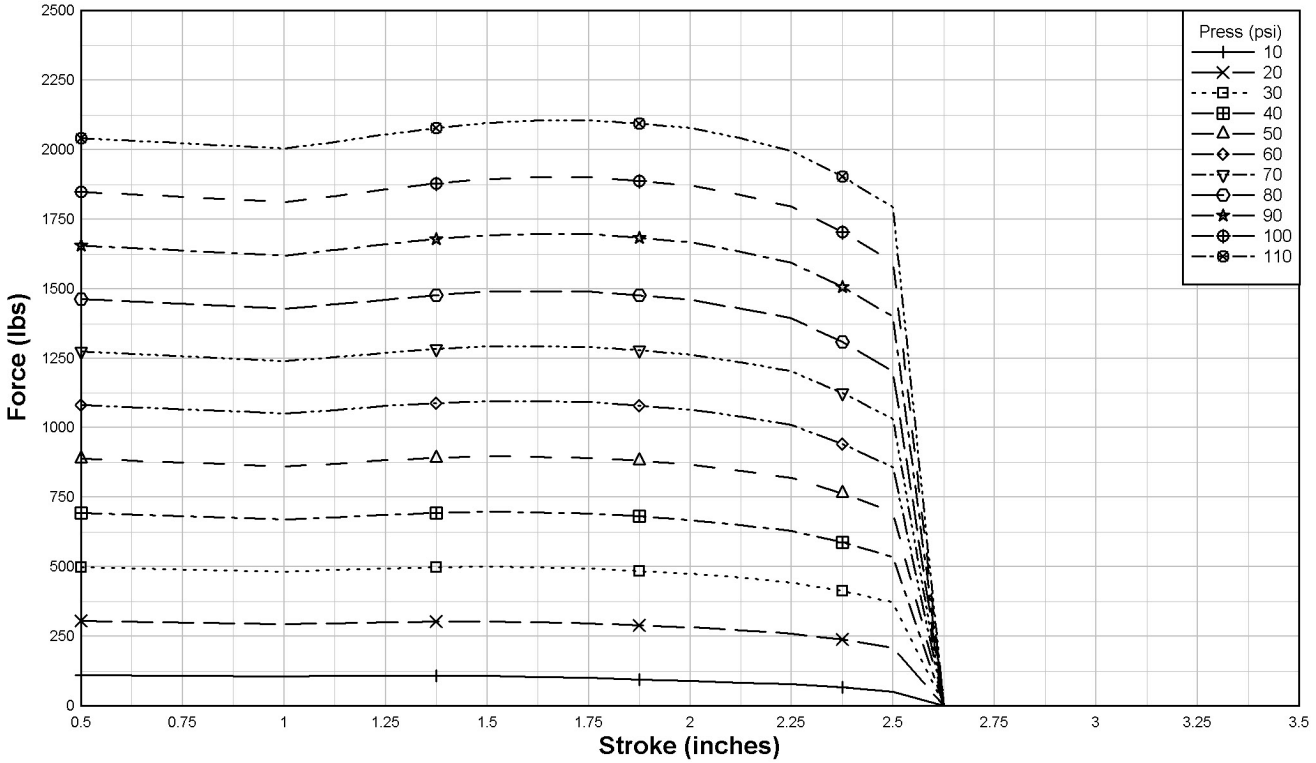
Brake Chamber Pushrod Force
Type 18



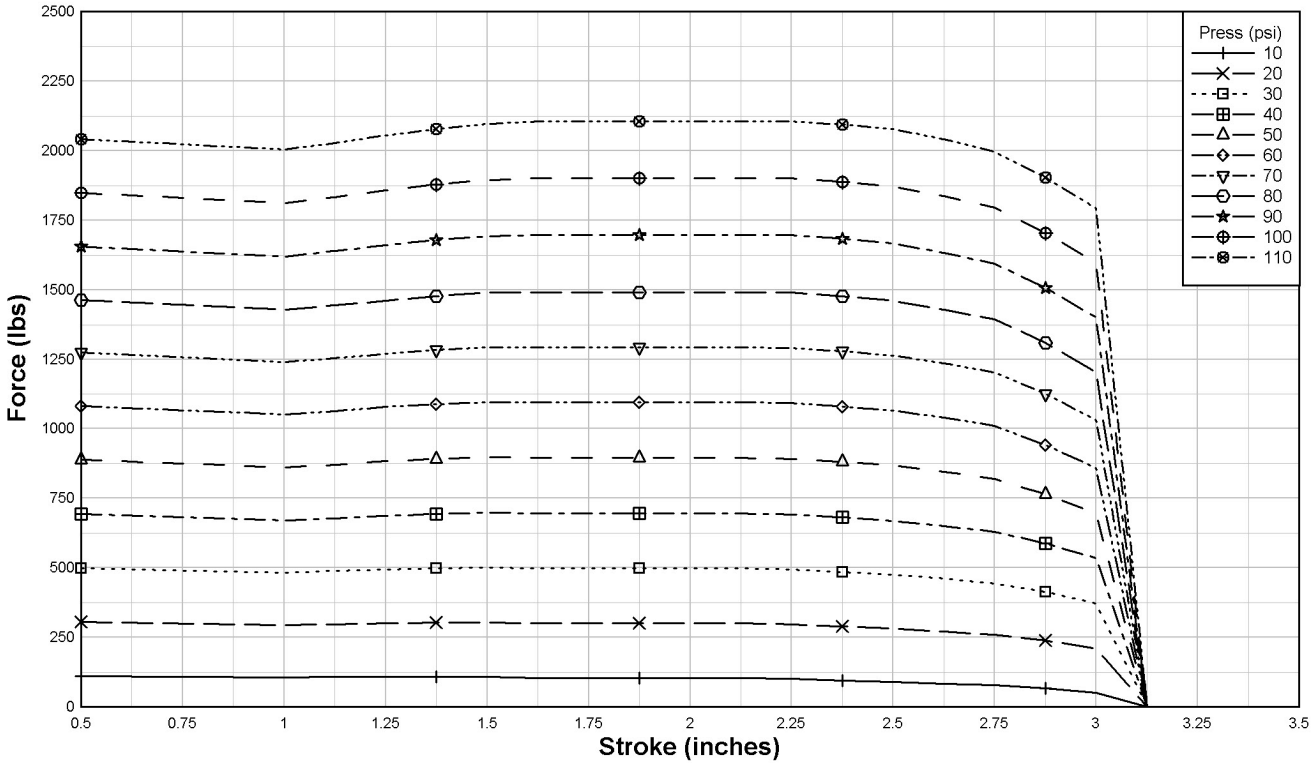
Brake Chamber Pushrod Force
Type 20



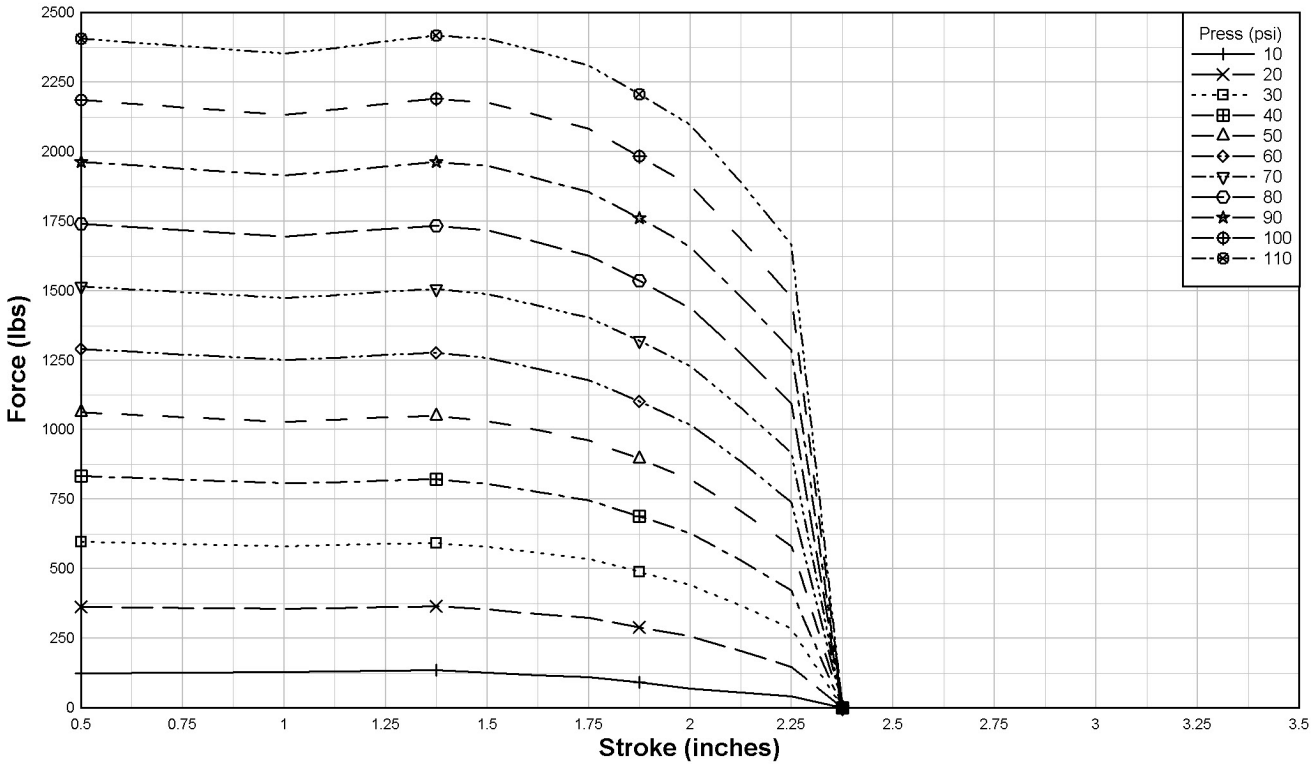
Brake Chamber Pushrod Force
Type 20 Long Stroke



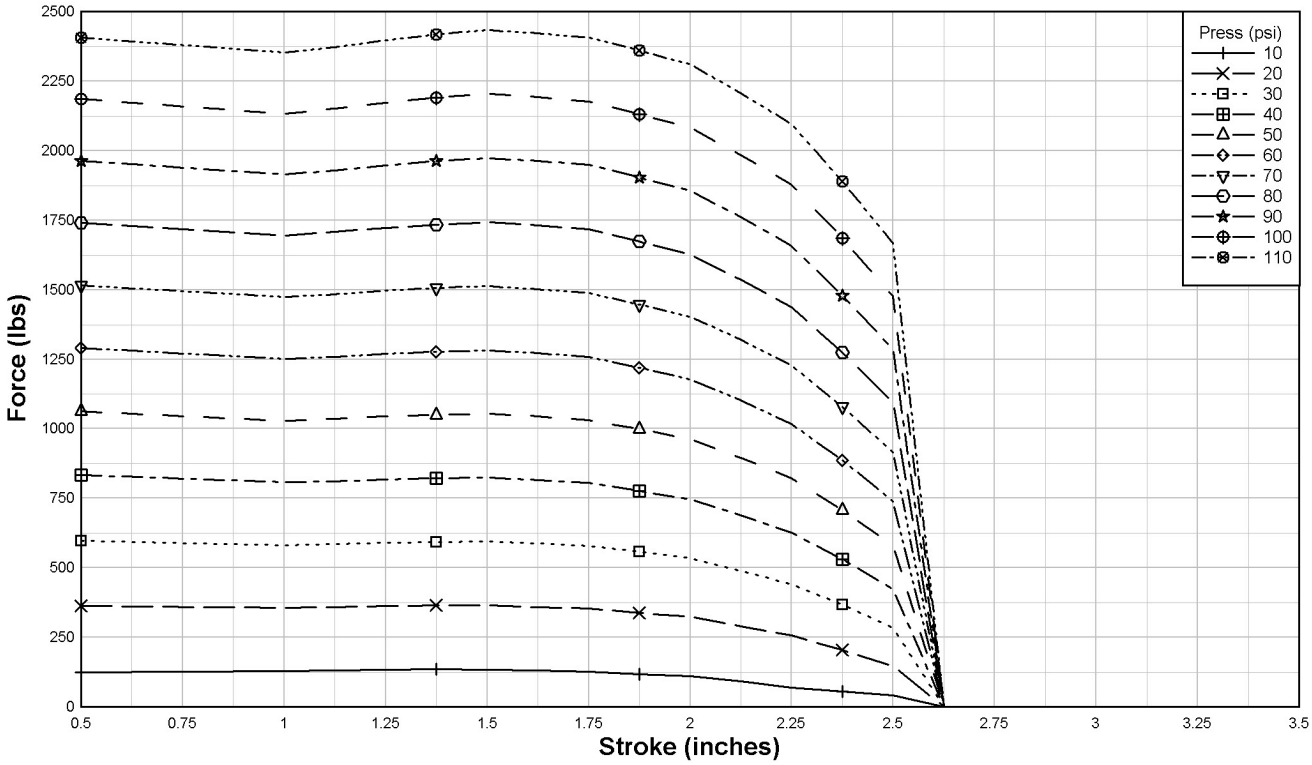
Brake Chamber Pushrod Force
Type 20 Extra Long Stroke



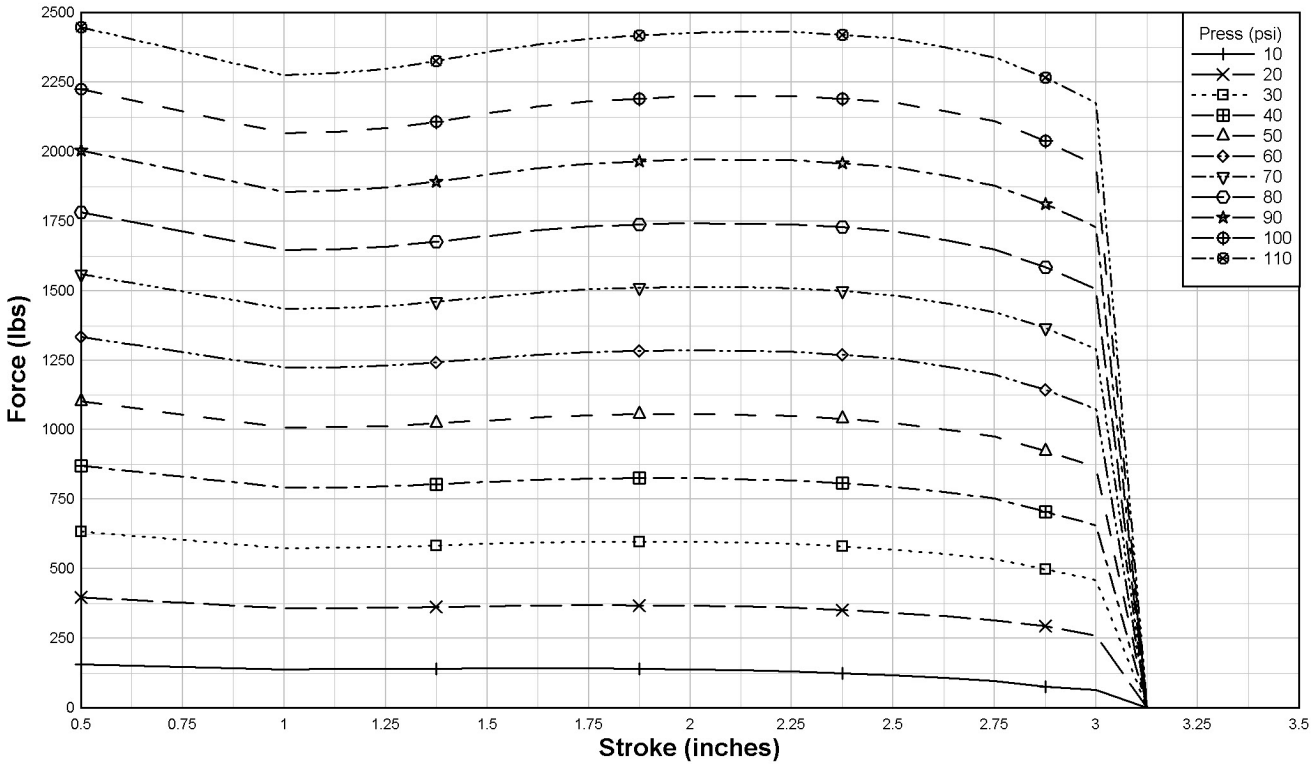
Brake Chamber Pushrod Force
Type 24



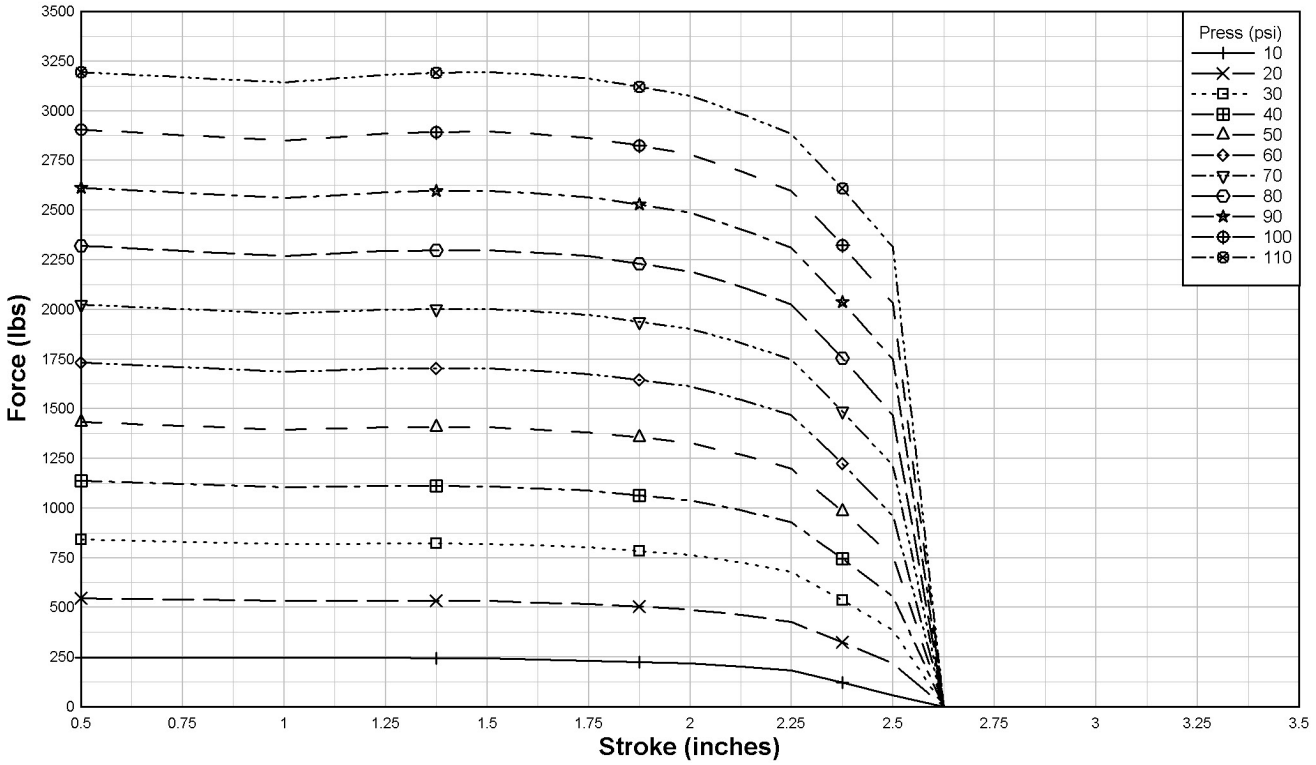
Brake Chamber Pushrod Force
Type 24 Long Stroke



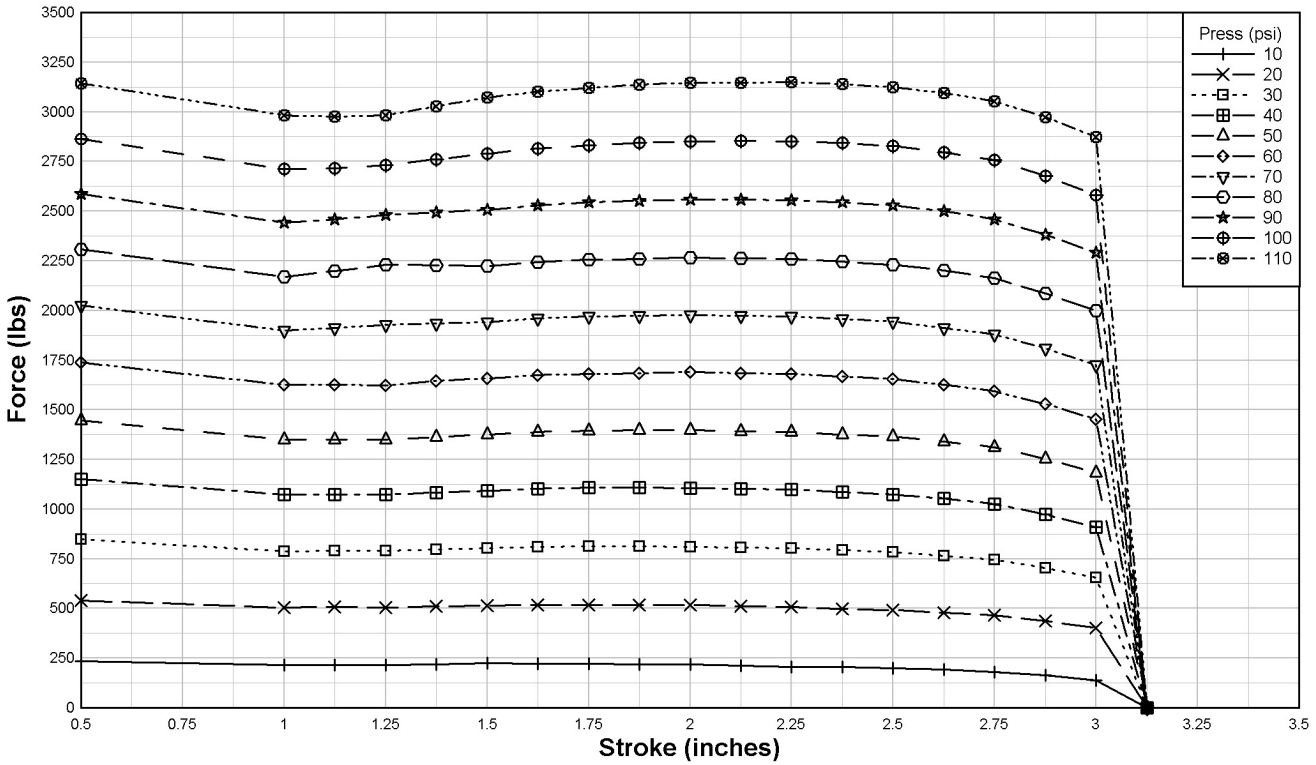
Brake Chamber Pushrod Force
Type 24 Extra Long Stroke



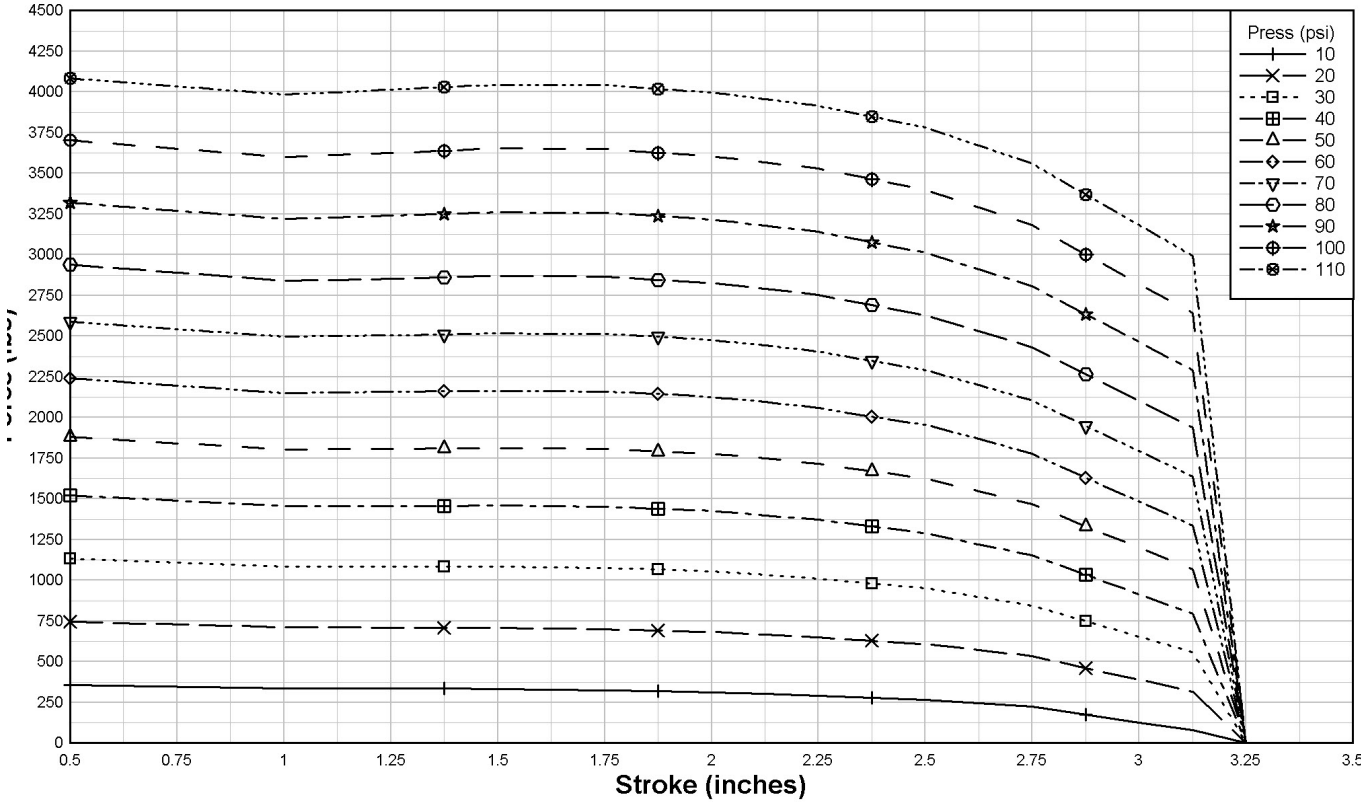
Brake Chamber Pushrod Force
Type 30



Brake Chamber Pushrod Force
Type 30 Long Stroke



Brake Chamber Pushrod Force
Type 36



Type 9 Pushrod Forces (lbs)											
Stroke	Pressure (psi)										
(inches)	10	20	30	40	50	60	70	80	90	100	110
0.500	25	120	210	300	390	480	573	665	758	850	945
1.000	25	120	205	290	375	460	558	655	743	830	930
1.125	30	120	205	290	380	470	563	655	743	830	930
1.250	30	120	200	280	368	455	548	640	730	820	915
1.375	25	120	185	250	335	420	508	595	685	775	875
1.500	25	105	175	245	318	390	473	555	643	730	830
1.625	20	85	145	205	278	350	430	510	580	650	770
1.750	10	50	98	145	203	260	330	400	470	540	640
1.875	0	15	50	85	128	170	240	310	370	430	510
2.000	0	0	0	0	40	80	140	200	240	280	390
2.125	0	0	0	0	0	0	0	0	0	0	0

Type 12 Pushrod Forces (lbs)											
Stroke	Pressure (psi)										
(inches)	10	20	30	40	50	60	70	80	90	100	110
0.500	74	195	315	435	554	673	793	912	1030	1148	1266
1.000	80	192	312	431	549	666	785	904	1023	1141	1260
1.125	78	194	312	430	549	667	786	905	1025	1144	1264
1.250	76	191	309	426	545	663	783	903	1023	1143	1263
1.375	72	186	303	419	536	653	773	892	1012	1131	1251
1.500	68	178	292	406	522	637	754	870	988	1106	1224
1.625	61	166	275	384	496	607	721	834	948	1062	1176
1.750	50	149	251	353	459	564	672	779	888	997	1106
1.875	38	125	216	307	404	500	600	700	803	905	1008
2.000	0	0	0	0	0	0	0	0	0	0	0

Type 12LS Pushrod Forces (lbs)											
Stroke	Pressure (psi)										
(inches)	10	20	30	40	50	60	70	80	90	100	110
0.500	74	195	315	435	554	673	793	912	1030	1148	1266
1.000	80	192	312	431	549	666	785	904	1023	1141	1260
1.125	78	194	312	430	549	667	786	905	1025	1144	1264
1.250	76	191	309	426	545	663	783	903	1023	1143	1263
1.375	72	186	303	419	536	653	773	892	1012	1131	1251
1.500	72	186	303	419	536	653	773	892	1012	1131	1251
1.625	72	186	303	419	536	653	773	892	1012	1131	1251
1.750	68	178	292	406	522	637	754	870	988	1106	1224
1.875	61	166	275	384	496	607	721	834	948	1062	1176
2.000	50	149	251	353	459	564	672	779	888	997	1106
2.125	38	125	216	307	404	500	600	700	803	905	1008
2.250	0	0	0	0	0	0	0	0	0	0	0

Type 16 Pushrod Forces (lbs)											
Stroke	Pressure (psi)										
(inches)	10	20	30	40	50	60	70	80	90	100	110
0.500	114	286	453	619	783	946	1107	1268	1427	1585	1744
1.000	121	277	437	597	753	909	1067	1224	1378	1532	1686
1.125	120	281	441	600	760	919	1078	1236	1393	1549	1706
1.250	123	285	447	609	769	929	1090	1250	1410	1570	1730
1.375	124	285	450	615	777	939	1104	1268	1429	1590	1751
1.500	123	288	453	617	783	948	1113	1278	1443	1608	1773
1.625	122	286	453	619	784	948	1114	1280	1446	1612	1778
1.750	119	282	448	614	779	943	1110	1277	1443	1608	1774
1.875	116	280	443	606	771	935	1100	1264	1430	1596	1762
2.000	115	273	435	596	756	916	1080	1244	1408	1572	1736
2.125	112	266	423	579	737	894	1055	1215	1377	1539	1701
2.250	108	254	404	554	706	858	1013	1168	1328	1488	1648
2.375	97	228	369	510	654	797	947	1096	1251	1405	1560
2.500	60	160	295	430	565	700	845	990	1145	1300	1455
2.625	0	0	0	0	0	0	0	0	0	0	0

Type 16LS Pushrod Forces (lbs)											
Stroke	Pressure (psi)										
(inches)	10	20	30	40	50	60	70	80	90	100	110
0.500	114	286	453	619	783	946	1107	1268	1427	1585	1744
1.000	121	277	437	597	753	909	1067	1224	1378	1532	1686
1.125	120	281	441	600	760	919	1078	1236	1393	1549	1706
1.250	123	285	447	609	769	929	1090	1250	1410	1570	1730
1.375	124	285	450	615	777	939	1104	1268	1429	1590	1751
1.500	123	288	453	617	783	948	1113	1278	1443	1608	1773
1.625	123	288	453	617	783	948	1113	1278	1443	1608	1773
1.750	123	288	453	617	783	948	1113	1278	1443	1608	1773
1.875	122	286	453	619	784	948	1114	1280	1446	1612	1778
2.000	119	282	448	614	779	943	1110	1277	1443	1608	1774
2.125	116	280	443	606	771	935	1100	1264	1430	1596	1762
2.250	115	273	435	596	756	916	1080	1244	1408	1572	1736
2.375	112	266	423	579	737	894	1055	1215	1377	1539	1701
2.500	108	254	404	554	706	858	1013	1168	1328	1488	1648
2.625	97	228	369	510	654	797	947	1096	1251	1405	1560
2.750	60	160	295	430	565	700	845	990	1145	1300	1455
2.875	0	0	0	0	0	0	0	0	0	0	0

Type 18 Pushrod Forces (lbs)											
Stroke	Pressure (psi)										
(inches)	10	20	30	40	50	60	70	80	90	100	110
0.500	148	337	534	729	879	1062	1245	1413	1602	1765	1962
1.000	118	312	489	679	854	1046	1229	1416	1605	1795	1989
1.125	121	306	494	678	861	1044	1230	1416	1619	1772	1966
1.250	110	303	492	682	860	1046	1244	1424	1629	1820	1979
1.375	97	295	495	667	880	1070	1255	1453	1640	1844	1932
1.500	68	256	441	624	826	995	1200	1389	1578	1773	1958
1.625	65	245	431	621	808	1001	1193	1384	1589	1794	1983
1.750	62	244	428	617	807	999	1192	1387	1585	1791	1970
1.875	52	237	426	612	808	998	1193	1394	1588	1790	1969
2.000	46	240	418	608	799	991	1186	1385	1577	1776	1976
2.125	40	222	410	597	789	978	1172	1366	1564	1761	1940
2.250	29	218	397	583	770	958	1151	1344	1537	1737	1933
2.375	25	208	382	565	752	935	1122	1311	1502	1698	1891
2.500	16	188	364	539	716	894	1074	1263	1454	1639	1829
2.625	8	169	336	504	676	854	1030	1209	1391	1568	1749
2.750	1	146	301	462	624	787	958	1131	1307	1484	1640
2.875	0	0	0	0	0	0	0	0	0	0	0

Type 20 Pushrod Forces (lbs)											
Stroke	Pressure (psi)										
(inches)	10	20	30	40	50	60	70	80	90	100	110
0.500	111	305	499	693	888	1082	1273	1463	1656	1848	2040
1.000	106	294	483	671	862	1052	1240	1427	1619	1811	2003
1.125	107	297	488	678	871	1064	1254	1443	1638	1832	2026
1.250	108	300	494	687	883	1078	1270	1461	1659	1857	2055
1.375	108	303	498	693	891	1088	1283	1477	1677	1877	2078
1.500	108	304	501	697	897	1096	1293	1489	1692	1894	2097
1.625	95	289	485	681	881	1080	1278	1476	1682	1888	2093
1.750	89	282	476	669	867	1065	1263	1460	1666	1871	2077
1.875	83	271	461	650	845	1040	1235	1429	1633	1837	2040
2.000	77	259	444	628	819	1010	1202	1393	1594	1795	1996
2.125	67	239	414	588	765	942	1126	1309	1507	1704	1902
2.250	51	209	372	534	696	858	1031	1204	1401	1597	1794
2.375	0	0	0	0	0	0	0	0	0	0	0

Type 20LS Pushrod Forces (lbs)											
Stroke	Pressure (psi)										
(inches)	10	20	30	40	50	60	70	80	90	100	110
0.500	111	305	499	693	888	1082	1273	1463	1656	1848	2040
1.000	106	294	483	671	862	1052	1240	1427	1619	1811	2003
1.125	107	297	488	678	871	1064	1254	1443	1638	1832	2026
1.250	108	300	494	687	883	1078	1270	1461	1659	1857	2055
1.375	108	303	498	693	891	1088	1283	1477	1677	1877	2078
1.500	108	304	501	697	897	1096	1293	1489	1692	1894	2097
1.625	104	301	498	695	895	1095	1293	1491	1696	1900	2104
1.750	100	297	494	690	891	1092	1291	1490	1696	1901	2106
1.875	95	289	485	681	881	1080	1278	1476	1682	1888	2093
2.000	89	282	476	669	867	1065	1263	1460	1666	1871	2077
2.125	83	271	461	650	845	1040	1235	1429	1633	1837	2040
2.250	77	259	444	628	819	1010	1202	1393	1594	1795	1996
2.375	67	239	414	588	765	942	1126	1309	1507	1704	1902
2.500	51	209	372	534	696	858	1031	1204	1401	1597	1794
2.625	0	0	0	0	0	0	0	0	0	0	0

Type 20XLS Pushrod Forces (lbs)											
Stroke	Pressure (psi)										
(inches)	10	20	30	40	50	60	70	80	90	100	110
0.500	111	305	499	693	888	1082	1273	1463	1656	1848	2040
1.000	106	294	483	671	862	1052	1240	1427	1619	1811	2003
1.125	107	297	488	678	871	1064	1254	1443	1638	1832	2026
1.250	108	300	494	687	883	1078	1270	1461	1659	1857	2055
1.375	108	303	498	693	891	1088	1283	1477	1677	1877	2078
1.500	108	304	501	697	897	1096	1293	1489	1692	1894	2097
1.625	104	301	498	695	895	1095	1293	1491	1696	1900	2104
1.750	104	301	498	695	895	1095	1293	1491	1696	1900	2104
1.875	104	301	498	695	895	1095	1293	1491	1696	1900	2104
2.000	104	301	498	695	895	1095	1293	1491	1696	1900	2104
2.125	104	301	498	695	895	1095	1293	1491	1696	1900	2104
2.250	100	297	494	690	891	1092	1291	1490	1696	1901	2106
2.375	95	289	485	681	881	1080	1278	1476	1682	1888	2093
2.500	89	282	476	669	867	1065	1263	1460	1666	1871	2077
2.625	83	271	461	650	845	1040	1235	1429	1633	1837	2040
2.750	77	259	444	628	819	1010	1202	1393	1594	1795	1996
2.875	67	239	414	588	765	942	1126	1309	1507	1704	1902
3.000	51	209	372	534	696	858	1031	1204	1401	1597	1794
3.125	0	0	0	0	0	0	0	0	0	0	0

Type 24 Pushrod Forces (lbs)											
Stroke	Pressure (psi)										
(inches)	10	20	30	40	50	60	70	80	90	100	110
0.500	124	363	598	833	1062	1291	1516	1740	1963	2185	2407
1.000	128	355	581	807	1029	1251	1473	1695	1914	2133	2352
1.125	131	359	585	811	1035	1259	1484	1708	1929	2150	2371
1.250	134	363	591	818	1044	1270	1496	1722	1947	2172	2397
1.375	135	364	593	822	1049	1276	1505	1734	1962	2189	2417
1.500	126	353	579	805	1031	1257	1488	1718	1948	2177	2407
1.625	118	338	558	777	999	1220	1447	1673	1902	2130	2359
1.750	110	323	535	747	963	1178	1402	1626	1854	2082	2310
1.875	91	290	489	688	895	1101	1319	1536	1760	1983	2207
2.000	70	256	441	626	822	1018	1228	1438	1658	1878	2097
2.125	56	204	367	530	708	886	1080	1274	1479	1684	1890
2.250	41	148	285	422	581	739	917	1095	1286	1476	1667
2.375	0	0	0	0	0	0	0	0	0	0	0

Type 24LS Pushrod Forces (lbs)											
Stroke	Pressure (psi)										
(inches)	10	20	30	40	50	60	70	80	90	100	110
0.500	124	363	598	833	1062	1291	1516	1740	1963	2185	2407
1.000	128	355	581	807	1029	1251	1473	1695	1914	2133	2352
1.125	131	359	585	811	1035	1259	1484	1708	1929	2150	2371
1.250	134	363	591	818	1044	1270	1496	1722	1947	2172	2397
1.375	135	364	593	822	1049	1276	1505	1734	1962	2189	2417
1.500	133	364	595	825	1054	1282	1513	1743	1973	2203	2433
1.625	130	359	587	815	1044	1272	1502	1731	1962	2192	2423
1.750	126	353	579	805	1031	1257	1488	1718	1948	2177	2407
1.875	118	338	558	777	999	1220	1447	1673	1902	2130	2359
2.000	110	323	535	747	963	1178	1402	1626	1854	2082	2310
2.125	91	290	489	688	895	1101	1319	1536	1760	1983	2207
2.250	70	256	441	626	822	1018	1228	1438	1658	1878	2097
2.375	56	204	367	530	708	886	1080	1274	1479	1684	1890
2.500	41	148	285	422	581	739	917	1095	1286	1476	1667
2.625	0	0	0	0	0	0	0	0	0	0	0

Type 24XLS Pushrod Forces (lbs)											
Stroke	Pressure (psi)										
(inches)	10	20	30	40	50	60	70	80	90	100	110
0.500	157	397	634	871	1103	1334	1558	1781	2003	2225	2447
1.000	138	358	575	792	1008	1223	1434	1645	1855	2065	2275
1.125	139	359	576	793	1009	1224	1436	1648	1859	2070	2281
1.250	140	360	578	796	1013	1230	1444	1657	1871	2084	2297
1.375	141	362	583	803	1023	1242	1459	1676	1892	2108	2325
1.500	143	365	589	812	1034	1256	1477	1697	1918	2138	2358
1.625	143	368	594	820	1045	1269	1493	1717	1940	2162	2385
1.750	142	369	597	825	1052	1278	1505	1731	1957	2182	2407
1.875	139	368	597	826	1055	1284	1511	1738	1965	2191	2418
2.000	137	368	597	826	1056	1286	1514	1742	1971	2199	2427
2.125	135	365	594	822	1053	1284	1512	1740	1970	2200	2430
2.250	130	360	589	817	1049	1280	1509	1738	1969	2199	2430
2.375	124	352	580	808	1039	1269	1499	1728	1959	2190	2420
2.500	117	343	569	795	1025	1255	1484	1713	1945	2176	2408
2.625	108	330	553	775	1002	1229	1456	1683	1915	2146	2377
2.750	97	315	534	752	976	1199	1424	1649	1879	2109	2339
2.875	76	294	499	704	924	1144	1365	1585	1812	2039	2266
3.000	65	260	458	656	865	1074	1290	1506	1729	1951	2174
3.125	0	0	0	0	0	0	0	0	0	0	0

Type 30 Pushrod Forces (lbs)											
Stroke	Pressure (psi)										
(inches)	10	20	30	40	50	60	70	80	90	100	110
0.500	249	547	842	1137	1435	1732	2026	2319	2612	2904	3196
1.000	247	533	819	1104	1396	1688	1979	2270	2561	2852	3143
1.125	248	534	821	1108	1402	1695	1988	2281	2575	2868	3161
1.250	248	535	824	1112	1408	1703	1999	2294	2590	2886	3181
1.375	245	533	823	1112	1409	1705	2002	2299	2597	2894	3192
1.500	243	532	821	1110	1407	1704	2002	2299	2598	2896	3195
1.625	237	525	813	1100	1396	1691	1989	2286	2585	2883	3181
1.750	233	516	802	1088	1382	1676	1972	2268	2566	2864	3162
1.875	224	504	784	1064	1355	1646	1939	2232	2529	2826	3122
2.000	217	489	764	1039	1326	1612	1902	2192	2487	2781	3076
2.125	201	462	726	989	1268	1547	1831	2114	2405	2696	2987
2.250	183	429	679	929	1199	1469	1747	2024	2310	2596	2882
2.375	122	326	537	747	985	1223	1489	1754	2039	2324	2609
2.500	58	217	386	555	759	962	1214	1465	1748	2031	2314
2.625	0	0	0	0	0	0	0	0	0	0	0

Type 30LS Pushrod Forces (lbs)											
Stroke	Pressure (psi)										
(inches)	10	20	30	40	50	60	70	80	90	100	110
0.500	234	541	847	1152	1446	1739	2024	2309	2587	2865	3143
1.000	214	504	789	1074	1351	1627	1899	2171	2442	2713	2984
1.125	215	507	791	1074	1350	1626	1912	2198	2458	2717	2977
1.250	215	505	790	1075	1350	1624	1928	2231	2482	2732	2983
1.375	220	512	797	1082	1363	1644	1936	2228	2495	2761	3027
1.500	226	514	804	1093	1376	1659	1942	2224	2507	2790	3073
1.625	223	519	811	1102	1388	1674	1959	2243	2529	2815	3101
1.750	222	518	814	1109	1396	1682	1969	2255	2544	2832	3120
1.875	219	517	813	1108	1397	1685	1973	2261	2553	2845	3137
2.000	218	516	810	1104	1397	1689	1977	2265	2559	2852	3146
2.125	212	510	807	1103	1393	1683	1973	2263	2558	2853	3148
2.250	207	509	804	1098	1389	1680	1970	2259	2556	2852	3149
2.375	205	499	793	1086	1377	1668	1958	2247	2545	2843	3140
2.500	200	493	784	1075	1365	1655	1944	2232	2530	2827	3124
2.625	192	479	766	1053	1339	1625	1913	2201	2499	2797	3095
2.750	181	465	745	1025	1310	1595	1879	2163	2460	2756	3052
2.875	164	436	705	973	1252	1531	1809	2086	2382	2677	2972
3.000	138	401	656	910	1182	1453	1726	1999	2291	2582	2873
3.125	0	0	0	0	0	0	0	0	0	0	0

Type 36 Pushrod Forces (lbs)											
Stroke	Pressure (psi)										
(inches)	10	20	30	40	50	60	70	80	90	100	110
0.500	353.5	743	1133	1522	1880	2238	2588	2938	3320	3702	4084
1.000	336.5	709	1082	1454	1802	2150	2494	2837	3219	3600	3982
1.125	336	709	1082	1455	1804	2153	2499	2844	3228	3612	3996
1.250	334.5	708	1082	1455	1806	2156	2504	2851	3238	3624	4011
1.375	333	707	1082	1456	1808	2160	2510	2859	3249	3638	4027
1.500	330.5	706	1082	1457	1810	2163	2515	2867	3259	3651	4043
1.625	327	703	1079	1455	1808	2161	2514	2866	3258	3650	4041
1.750	324	700	1076	1452	1806	2159	2512	2865	3257	3648	4040
1.875	317	691	1065	1439	1791	2143	2494	2845	3236	3626	4017
2.000	310	682	1054	1426	1776	2126	2476	2825	3215	3604	3994
2.125	300	666	1032	1398	1746	2093	2441	2788	3177	3566	3954
2.250	290	650	1010	1370	1715	2059	2405	2751	3139	3527	3915
2.375	278	629	980	1330	1668	2006	2348	2690	3076	3462	3848
2.500	265.5	607	949	1290	1622	1953	2291	2629	3013	3397	3781
2.625	244	570	896	1221	1544	1866	2198	2530	2910	3290	3670
2.750	222	532	842	1152	1465	1778	2105	2431	2807	3183	3559
2.875	174	460	747	1033	1332	1630	1948	2266	2634	3002	3369
3.000	125	388	651	914	1198	1482	1792	2101	2461	2820	3180
3.125	77	316	556	795	1065	1334	1635	1936	2288	2639	2990
3.250	0	0	0	0	0	0	0	0	0	0	0